"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye.A

Barbašin, E. A. On the existence of smooth solutions of some linear partial differential equations. Doklady Akad. Nauk SSSR. (N.S.) 72, 445-447 (1950). (Russian)

Consider the system (1): $\dot{x}=X(x)$, where $x=(x_1, x_2, \cdots)$ is a point in Euclidean n-space E_n and $X=(X_1, X_2, \cdots)$ are

on S and each $\varphi(x)\epsilon C$, defined in G, a $v(x)\epsilon C$, exists such that $\sum X_i\cdot(\partial v/\partial x_i)=\varphi$ in G, $v=\psi$ on S. A theorem of Kamke asserts the existence of a regular first integral for $n=2$; for $n>2$ this is not true in general but the following result holds. Theorem 2. If G is homeomorphic to E_n and if the

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Source: Mathematical Reviews, Vol 12, No. 3

BARBASHIN, Ye. A.

"Method of Cross Sections in the Theory of Dynamic Systems." Sub 22 Mar 51, Mathematics Inst imeni V. A. Steklov, Acad of Sciences USSR.

Dissertations presented for science and engineering degrees in Moscow during 1951.

SO: Sum. No. 480, 9 May 55.

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, YE. A.

PA 192T46

USSR/Mathematics - Dynamical Systems

"The Method of Cross Sections in t
Dynamical Systems," Ye. A. Barbash

"Matemat Sbor" Vol XXIX (71), No 2

Investigates dynamical systems in
grossen). Discusses rectifiable d
tems (i.e., possessing isomorphic
trajectories into a family of para
lines); existence of integrals of

USSR/Mathematics - Dynamical Systems (Contd

1st-order differential eqs; Liapoun
ity; uniformly dispersed dynamical
existence of secant (cutting) surfa
tegral invariants. Submitted 12 De

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye.A

Barbašin, E. A. On homomorphisms of dynamical systems. II. Mat. Sbornik N.S. 29(71), 501-518 (1951). (Russian)

[For part I see Mat. Sbornik N.S. 27(69), 455-470 (1950); these Rev. 12, 422.] This paper concerns sections of dynamical systems, covering dynamical systems and their connections with the author's K-homomorphisms and I-homomorphisms which are essentially homomorphisms of a dynamical system onto the circle group and line group. Typical result: If a dynamical system in a simply connected space has a K-homomorphism, then it has a I-homomorphism such that the I-section is a component of the K-section.

W. H. Gottschalk (Philadelphia, Pa.).

Source: Mathematical Reviews, Vol 13 No.5

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye. A.
~~BARBASIN, E. A.~~

"The Stability of the Solutions of a Non-linear Equation of the Third Order"

Prik Mat Mech 16, 629-632, 1951

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, E.A.

Barbašin, E. A. On the stability of solution of a nonlinear equation of the third order. Akad. Nauk SSSR. Prikl. Mat. Meh. **16**, 629–632 (1952). (Russian)

Study of the stability of the solution $x=0$ of the third order equation

(1) $$x+a\ddot{x}+\varphi(\dot{x})+f(x)=0$$

where a is a positive constant, f is continuously differentiable for all x, $\varphi(y)$ is continuous for all y, and $f(0)=\varphi(0)=0$. Set:

$$F(x)=\int_0^x f(x)dy,\quad \Phi=\int_0^y \varphi(y)dy,$$

$$w(x,y)=aF(x)+f(x)y+\Phi(y).$$

Replace also (1) by

(2) $$\dot{x}=y,\quad \dot{y}=z-ay,\quad \dot{z}=-f(x)-\varphi(y).$$

It is proved that the origin as a solution is asymptotically stable whatever the initial position under one of the following two sets of conditions: I. $f(x)/x>0$ for $x\neq0$; $\varphi(y)/y-f'(x)>0$ for $y\neq0$; $w(x,y)\to+\infty$ with $(x^2+y^2)^{1/2}$. II. There exist two positive numbers h_1, h_2 such that $ah_2-h_1>0$ and such that $f(x)/x>h_1$ for $x\neq0$;

$$a\varphi(y)/y-f'(x)>ah_2-h_1.$$

In the special case $f(x)=bx$, $b>0$, the same stability result is obtained under the conditions:

$$\frac{\varphi(y)}{y}>\frac{b}{a}\text{ for } y\neq0;\quad \Phi(y)-b\frac{y^2}{2a}\to+\infty \text{ as } |y|\to\infty.$$

References: Malkin, same journal **16**, 365–368 (1952); these Rev. **14**, 48; Barbašin, Učenye Zapiski Moskov. Gos. Univ. **135**, Matematika **2**, 110–133 (1948); these Rev. **1**, 443].

S. Lefschetz (Princeton, N. J.).

SO: MATHEMATICAL REVIEW (unclassified)
Vol XIV, No 4, April 1953, pp 341-438

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, YE. A.

Barbašin, E. A., and **Krasovskii, N. N.** On stability of motion in the large. Doklady Akad. Nauk SSSR (N.S.) 86, 453–456 (1952). (Russian)

The authors consider differential equations (1) $\dot{x}=X(x)$, where x is a vector in n-dimensional space and the components X_i of X are of class C' everywhere, with $X(0)=0$. The solution $x\equiv 0$ is said to be asymptotically stable for arbitrary initial conditions if (*) every solution $x(t)$ of (1) tends to 0 as $t\to+\infty$. Existence of a differentiable function $v(x)$, everywhere positive, such that $\dot{v}<0$ on each solution would, according to Liapounoff's theory, guarantee a local stability of the solution $x\equiv 0$. It is shown by an example that this need not imply (*). If, in addition, $v(x)\to\infty$ as $\|x\|\to\infty$, then it is shown that (*) does follow. Conversely, if (*) holds, then such a v does exist. If the condition $\dot{v}<0$ is replaced by the conditions: $\dot{v}<0$ outside of M, $\dot{v}\leq 0$ in M, and M is a set such that the intersection of each level surface $v=c$ and M contains no positive semi-trajectory of (1), then (*) again follows. It is shown that these hypotheses are satisfied by the system of second order: $\dot{x}=y$, $\dot{y}=-\phi(y)-g(y)f(x)$, provided $f(0)=\phi(0)=0$, $xf(x)>0$ for $x\neq 0$, $y\phi(y)>0$ for $y\neq 0$, $g(y)>0$, $\int_0^x f(x)dx\to\infty$ as $|x|\to\infty$ and $\int_0^y yg(y)^{-1}dy\to\infty$ as $y\to\infty$. In the proofs use is made of results of a previous paper by Barbašin [Mat. Sbornik N.S. 29(71), 233–280 (1951); these Rev. 13, 756].

W. Kaplan (Ann Arbor, Mich.).

Mathematical Reviews
Vol. 14 No. 7
July-August 1953
Analysis

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye.A.; KRASOVSKIY, N.N.

Existence of Liapunov's functions in the case of asymptotic stability in the large. Prikl.mat. i mekh. 18 no.3:345-350 My-Je '54. (MLRA 7:7)
(Stability)

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, YE. A.

On the Behavior of Points in Homemorphic Transormations of a Space (Generalization of Brickhoff's Theorems)
Tr. Ural'sk. Politekhn. in-ta, No 51, 1954, pp4-11

The author presents in greater detail rusults which he had published earlier in Dok Ak Nauk USSR, Vol 51, 1946, pp 3-5. He considers the problem of an arbitrary compact and the semiordered group of its homemorphisms onto itself. He introduces the concept of a trajectory of points and defines wandering, fixed, recurrent, and center points. Five theorems on the behavior of these points conclude the article. (RZhMat, No 5, 1955)

SO: Sum. No. 639, 2 Sep 55

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

FD-2859

USSR/Mathematics - Stability

Card 1/2 Pub. 85-12/16

Author : Barbashin, Ye. A.; Skalkina, M. A. (Sverdlovsk)

Title : Problem of stability in the first approximation

Periodical : Prikl. mat. i mekh., 19, Sep-Oct 1955

Abstract : He considers the equations of the disturbed motion in the form $dy_s/dt = Y_s(t,y_1,\ldots,y_n) + R_s(t,y_1,\ldots,y_n)$ $(s=1,\ldots,n)$, where the functions Y_s and R_s are defined and continuous in the region $/y_s/ \leq H$, $t = [0,oo]$, and satisfy the Lipschitz conditions in $y_1,\ldots,y_n$ (Lipschitz constants L and K respectively); moreover, $Y_s(t,0,\ldots,0)=0$ identically, and $R_s(t,0,\ldots,0)=0$ identically. The authcr establishes a theorem that for sufficiently small R the zero solution of the above system will be asymptotically uniformly stable relative to t_o, $y_{10},\ldots,y_{no}$, if any solution of the equation $dx_s/dt = Y_s(t,x_1,\ldots,x_n)$ $(s=1,\ldots,n)$ for initial values $/x_s(t_o)/ \leq x < H$, $t_o = [0, oo]$ satisfy the inequality $/x_s(t)/ \leq Bx.\exp[-a(t-t_o)]$, where B,a are positive constants not depending on t_o, $x_{10},\ldots,x_{n0}$.

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

Card 2/2 FD-2859

Two references: V. V. Nemytskiy, V. V. Stepanov, Kachestvennaya teoriya differentsial'nykh uravneniy [Qualitative theory of differential equations], GITTL, Moscow-Leningrad, 1949; K. P. Persidskiy, "Theory of stability of integrals of systems of differential equations," Izvestiya fiz.-mat. ob-va pri Kazanskom un-ta, VIII, 1936-1937.

Institution :

Submitted : November 19, 1954

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

Barbashin, Ye. A.

Call Nr: AF 1108825

Transactions of the Third All-union Mathematical Congress (Cont.) Moscow, Jun-Jul '56, Trudy '56, V. 1, Sect. Rpts., Izdatel'stvo AN SSSR, Moscow, 1956, 237 pp.

Field method in the theory of hyperbolic systems of differential equations of mathematical physics.

Barbashin, Ye. A. (Sverdlovsk). Work of Sverdlovsk Seminar Members on the Qualitative Methods of the Theory of Differential Equations. 42-43

Mention is made of Skalkina, M. A., Repin, Yu. M., Yegorov, V. G., Lushnikova, Z. M., and Tabuyeva, V. A.

Bykov, Ya. V. (Moscow). On the Asymptotic Behavior of Solutions of Integral Differential Equations of Volterra Type. 43

Vol'pert, A. I. (Moscow). Investigation of a Boundary Problem for Elliptic Systems of Differential Equation in a Plane. 43-44

There is 1 USSR reference.

Card 14/80

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

~~BARBASHIN, Ye A~~ BARBAŠIN Ye A.

SUBJECT USSR/MATHEMATICS/Functional analysis CARD 1/1 PG - 673
AUTHOR BARBAŠIN E.A.
TITLE On two schemes for proofs of assertions of stability after the first approximation.
PERIODICAL Doklady Akad.Nauk 111, 9-11 (1956)
reviewed 4/1957

In a metric space R the author considers dynamical systems $f(p,t)$ and $g(p,t)$ which represent semigroups of the mappings of the R onto itself. For these systems the author defines the notions of uniform asymptotic stability, the ε-stability and the exponential stability of a set M. In two theorems from the stability of the set M for one system to the stability of M for the other system is concluded. The schemes of proof are due to Skalkina (Priklad.Mat. Mech 19, 287, (1955)) and Barbašin and Skalkina (Priklad.Mat.Mech.19, 623 (1955)).

INSTITUTION: Polytechnical Institute Ural.

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye.A.

Conditions under which the solutions of integrodifferential equations preserve their stability. Izv.vys.ucheb.zav.; mat. no.1:25-34 '57. (MIRA 12:10)

1. Ural'skiy politekhnicheskiy institut im. S.M.Kirova.
(Integral equations)

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

AUTHOR: Barbashin, Ye.A. and Baydosov, V.A. SOV/140-58-3-2/34

TITLE: ~~On the~~ Question of the Topological Definition of Integral Invariants (K voprosu o topologicheskom opredelenii integral'nykh invariantov)

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Matematika, 1958, Nr 3, pp 8-12 (USSR)

ABSTRACT: Basing on the theory of Eilenberg [Ref 1] the authors give a topological definition of the integral invariants of dynamic systems. A dynamic system (R,W) is the group W of the homeomorphic mappings of the topological space R onto itself. q-dimensional additive invariant cochains over the abelian topological group G are denoted as q-dimensional integral invariants of (R,W). An example for the application of these notions for the topological description of dynamic systems is the theorem: For the rectificability of (R,W) it is necessary and sufficient that there exists a continuous, invariant and admissible cochain f' homologous to zero. As rectificable the authors denote dynamic systems which admit isomorphic mappings for which the trajectories of the system pass over into parallel straight lines of the Hilbert space.

Card 1/2

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

On the Question of the Topological Definition of Integral Invariants SOV/140-58-3-2/34

There are 4 references, 2 of which are Soviet, and 2 American.

ASSOCIATION: Ural'skiy politekhnicheskiy institut imeni S.M.Kirova (Ural Polytechnic Institute imeni S.M. Kirov)

SUBMITTED: January 20, 1958

Card 2/2

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

16(1)

AUTHORS: Barbashin, Ye. A., and [illegible] SOV/[illegible]

TITLE: On the Stability of the Solutions of a System of Integro-Differential Equations (Ob ustoychivosti resheniy sistemy integro-differentsial'nykh uravneniy)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Fiziko-matematicheskiye nauki, 1958, Nr 3, pp 18-22 (USSR)

ABSTRACT: The author considers the system

$$(1)\quad \begin{cases} \dfrac{\partial\varphi(x,u,v)}{\partial u} = \displaystyle\int_a^b K_1(x,s,u,\varphi(s,u,v))ds + F_1(x,u,\varphi(x,u,v)) \\ \dfrac{\partial\varphi(x,u,v)}{\partial v} = \displaystyle\int_a^b K_2(x,s,v,\varphi(s,u,v))ds + F_2(x,v,\varphi(x,u,v)), \end{cases}$$

where the functions K_1, K_2, F_1, F_2 in D: $a\leq x$, $s\leq b$, $0\leq u$, $v<+\infty$, $|\varphi|<r$ belong to the class C_1, and the auxiliary equations

$$(2)\qquad \frac{d\varphi(x,u,v)}{du} = \int_a^b K_1(x,s,u,\varphi)ds + F_1(x,u,\varphi)$$

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$$(3)\qquad \frac{d\varphi(x,u,v)}{dv} = \int_a^b K_2(x,s,v,\varphi)\,ds + F_2(x,v,\varphi),$$

$$\text{where } \int_a^b \frac{\partial K_1}{\partial \varphi}\cdot\frac{\partial \varphi}{\partial v}\,ds + \frac{\partial F_1}{\partial \varphi}\cdot\frac{\partial \varphi}{\partial v} = \int_a^b \frac{\partial K_{\cdot}}{\partial \varphi}\cdot\frac{\partial \varphi}{\partial v}\ \ldots\ \frac{\partial F_3}{\partial \varphi}\cdot\frac{\partial \varphi}{\partial v}$$

It is shown that the stability (ordinary, [illegible] uniformly asymptotic) of the trivial solution of [illegible] is determined by the behavior of stability of the [illegible] of the equations (2) and (3). Five definitions and six [illegible] proved theorems are given.
There are 7 Soviet references.

ASSOCIATION: Ural'skiy politekhnicheskiy institut imeni S.M.Kirova (Ural Polytechnical Institute imeni S.M.Kirov)

SUBMITTED: March 25, 1958

Card 2/2

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

16(1) 05249

AUTHORS: Barbashin, Ye.A., and Tabuyeva, V.A. SOV/140-59-5-5/25

TITLE: On the Oscillation of a Pendulum Under Presence of Dry Friction

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Matematika, 1959, Nr 5, pp 48-57 (USSR)

ABSTRACT: Generalizing the pendulum equation with a dry friction the authors consider the equation

(3) $\ddot{x} + R(x,\dot{x}) + f(x) = 0,$

where $f(x) = f_1(x)$ for $\dot{x}>0$ and $f(x) = f_2(x)$ for $\dot{x}\leqslant 0$. Under numerous assumptions on R, f, and the zeros of f the qualitative course of the integral lines is discussed in detail. In the case $f_2(x)\leqslant f_1(x)$ four phase portraits different on principle are possible; in this case there exist no limit cycles. The authors give sufficient conditions for the existence of limit cycles in the general case. For the division into pieces of the integral lines the authors use essentially the results of Tabuyeva [Ref 1]. There are 5 figures, and 2 Soviet references.

ASSOCIATION: Ural'skiy politekhnicheskiy institut imeni S.M.Kirova (Urals Polytechnical Institute imeni S.M.Kirov)

SUBMITTED: April 3, 1959

Card 1/1

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye.A.; SHOLOKHOVICH, F.A.

Mapping a dynamic system into a dynamic system analytic with relations to time. Izv.vys.ucheb.zav.; mat. no.1:11-15 '60. (MIRA 13:6)

1. Ural'skiy politekhnicheskiy institut imeni S.M.Kirova i Ural'skiy gosudarstvennyy universitet imeni A.M.Gor'kogo. (Topology)

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye.A.; VDOVINA, E.V.

Conditions of singularity of limit cycles. Izv. vys. ucheb. zav.; mat. no. 3:43-47 '60. (MIRA 13:12)

1. Ural'skiy filial AN SSSR, Ural'skiy gosudarstvennyy universitet imeni A.M. Gor'kogo.
(Differential equations)

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

84470
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B012/B063

17.3000
(2212, 2107)

AUTHOR: Barbashin, Ye. A. (Sverdlovsk)

TITLE: Estimate of the Maximum of Deviation From a Given Trajectory 13

PERIODICAL: Avtomatika i telemekhanika, 1960, Vol. 21, No. 10, pp. 1341-1351

TEXT: In the present work, the author employs a method which he developed in Ref. 1 for estimating the maximum deviation from the motion along a given trajectory. A set of differential equations (1) is studied. Following the ideas put forward in Ref. 1, the author ignores the control functions which would guarantee an exact minimum for the quantity $\|z\|$. He gives several methods of estimation in the form of $\|z\| \leqslant A \|y\|$, where A is a constant, and $\|y\|$ is the deviation of another quantity, y, from zero. The difficult problem of determining min $\|z\|$ is replaced by the less difficult determination of min $\|y\|$. The first section deals with the estimate of the maximum of deviation and with the selection of control functions. It is shown that the method developed in Ref. 1 for the selection

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

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B012/B063

Estimate of the Maximum of Deviation From a Given Trajectory

of control functions and control vectors permits not only a diminution of the root-mean-square value of deviation but also a diminution of the maximum of deviation. The values of control functions determined from formula (10) are always independent of the time interval in which approximation is carried out. Nor do they depend on the control functions at any other instant. On the basis of the same method of selecting control functions (cf. formula (10)), the second section gives other methods of estimating the maximum of deviation. In both sections, the author mentions the relationship between the problem discussed here and that concerning the accumulation of disturbances. Proceeding from this point of view the author obtains results that are analogous to those published by B. V. Bulgakov (Refs. 3, 4). He points out that the character of all three estimates of $\| z \|$ given here depends on the functional space in which y is examined. The necessary explanations are given in an appendix. It is noted that the selection of control functions from formula (10) makes it also possible to find an optimal system of control vectors by the method described in the third section of Ref. 1. In the third section, the author investigates the approximation of trajectories for $T = \infty$. For this purpose, a limitation is imposed on the elements of the fundamental matrix.

Card 2/3

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

84479

Estimate of the Maximum of Deviation From a Given Trajectory

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B012/B063

The condition (21) described in Ref. 7, p. 366 is required to be satisfied. It is shown that the above-described method is most efficient if min $\|y\|$ is small and condition (21) is satisfied. It is noted that the case described in the third section ought to be discussed in connection with the problems of the theory of stability. The author regrets that he was not able to treat this problem in the way recommended by J. L. Massera and J. J. Schäffer (Ref. 5). Finally, he says that the method given in this paper eliminates all difficulties in calculation, permits a simple geometrical interpretation and simulation for the solution of the given problem. A paper by I. G. Malkin (Ref. 8) is mentioned. There are 9 references: 7 Soviet.

SUBMITTED: April 15, 1960

Card 3/3

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

88750

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C 111/ C 333

16.1500

AUTHOR: Barbashin, Ye. A. (Sverdlovsk)

TITLE: On a Problem of the Theory of Dynamic Programming

PERIODICAL: Prikladnaya matematika i mekhanika, 1960, Vol. 24, No. 6, pp. 1002-1012

TEXT: The author considers the equation

(1.1) $L(x) = x^{(n)} + a_1(t)x^{(n-1)} + \dots + a_n(t)x = c_1u_1(t) + \dots + c_mu_m(t)$

where $a_i(t)$ are continuous for $t \geqq 0$, $u_i(t)$ linearly independent and given, c_i are constants.

1. problem: Determine the c_i so that the solution $x(t)$ of (1) satisfying the initial conditions

(1.2) $x(0) = x_0,\ x'(0) = x_0',\dots,\ x^{(n-1)}(0) = x_0^{(n-1)}$

for $t = t_0 > 0$ satisfies the conditions

(1.3) $x(t_0) = f(t_0),\ x'(t_0) = f'(t_0),\ \dots,\ x^{(n-1)}(t_0) = f^{(n-1)}(t_0)$

where $f(t)$, $0 \leqq t \leqq T$, $0 < T \leqq \infty$ is given.

Card 1/6

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

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C 111/ C 333

On a Problem of the Theory of Dynamic Programming

2. problem: Determine the c_i so that the solution of (1.1) satisfying (1.3), approximates the given function $f(t)$ on $t_0 \leqq t \leqq T$.

Let $w_1(t,\tau)$, ..., $w_n(t,\tau)$ be linearly independent solutions of (1.1) which satisfy the conditions

$$(1.4) \qquad \left. \frac{d^k w_i(t,\tau)}{dt^k} \right|_{t=\tau} = \delta_{i,k+1}$$

where $\delta_{i,k+1}$ is the Kronecker symbol. Let

$$(1.6) \qquad y_i(t) = \int_0^t w_n(t,\tau)\, u_i(\tau)\, d\tau \qquad (i = 1,\dots, m) .$$

The author shows that in the first problem the c_i are to be chosen so that the system

$$(2.5) \qquad \sum_{i=1}^{m} c_i y_i^{(k)}(t_0) = r^{(k)}(t_0) \qquad (k = 0,1,\dots, (n-1))$$

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possesses a solution for $t = t_o > 0$; here it holds

$$r(t) = f(t) - \sum_{k=1}^{n} w_k(t,0)\, x_o^{(k-1)} .$$

Since (2.5) can be an incompatible system, the c_i are determined so that

$$(2.6) \quad F = \sum_{k=0}^{n-1} \left(\sum_{i=1}^{m} c_i y_i^{(k)} - r^{(k)} \right)^2$$

has a minimum ($y_i^{(k)}$ and $r^{(k)}$ are calculated in the point $t = t_o$). This minimum value is

$$(2.8) \quad H^2 = \frac{\Gamma(Y_1, \ldots, Y_p, R)}{\Gamma(Y_1, \ldots, Y_p)} ,$$

X

where $Y_1, \ldots, Y_p$ denote the $p(p \leqq n,\ p \leqq m)$ linearly independent vectors $Y_i(y_i, y_i', \ldots, y_i^{(n-1)})$, $i = 1,2,\ldots, m$; R the vector

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On a Problem of the Theory of Dynamic Programming

$R(r, r', \ldots, r^{(n-1)}$, and Γ the Gramm determinants of the corresponding vector systems.

Then the author considers the problem 1 with the restricting condition

(3.1) $\quad : (c_1, \ldots, c_m) \leqq M$.

If in this case the minimum of F is attained on the boundary, then the author recommends the method of M. Kreyn (Ref.11). He defines the function $\lambda(t_o, m)$ by

$$(3.4) \qquad \frac{1}{\lambda(t_o, m)} = \min \left\| \sum_{k=0}^{n-1} \gamma_k Y^k \right\|$$

under the condition

$$\sum_{k=0}^{n-1} \gamma_k r^{(k)} = 1 \text{ .}$$

Here it holds $Y^k = Y^k(y_1^{(k)}, \ldots, y_m^{(k)})$, and the norm depends on (3.1) which is understood as norm. Then system (2.5) has, according

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On a Problem of the Theory of Dynamic Programming

to (Ref. 11), one solution satisfying (3.1) if and only if $\lambda(t_o, m) \leqq M$. The author considers some examples; if e. g.

$$\varrho(c_1, \ldots, c_m) = \max_{1 \leq i \leq m} |c_i| \text{, then}$$

$$\frac{1}{\lambda(t_o, m)} = \min \sum_{i=1}^{m} \left| \sum_{k=0}^{n-1} \gamma_k y_i^{(k)} \right| \qquad \sum_{k=0}^{n-1} \gamma_k r^{(k)} = 1.$$

As the solution one obtains

$$c_i = \lambda(t_o, m) \operatorname{sign} \sum_{k=0}^{n-1} \gamma_k y_i^{(k)} \quad .$$

In order to solve the second problem the author puts $z = x - f(t)$ and seeks the c_i such that the solution of the resulting equation for z which satisfies the initial conditions

$z^{(k)}(t_o) = 0$, $K = 0, 1, \ldots, n-1$, approximates $z = 0$ best. The author states that the c_i are to be chosen so that

$$H^2 = \int_{t_o}^{T} \left(\sum_{i=1}^{m} c_i u_i(\tau) - \varphi(\tau) \right)^2 d\tau$$

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becomes a minimum, where $\varphi(\tau) = L(f(\tau))$. On the basis of preceding results the c_i must be determined from

$$(5.3) \qquad \sum_{k=1}^{m} (u_i, u_k)\, c_k = (u_i \varphi) \qquad (i = 1, \ldots, m).$$

Finally the author considers again the second problem according to Kreyn under the secondary condition

$$(5.4) \qquad \rho(c_1, \ldots, c_m) \leqq M \quad .$$

N. N. Krasovskiy, F. M. Kirillova and S.B. Stechkin are mentioned.

There are 15 references: 12 Soviet, 2 Polish and 1 American.

[Abstracter's note: (Ref.11) is the book of Ya. Akhiyezer and M. Kreyn: On Some Questions of the Theory of Moments;Khar'kov, 1938] .

ASSSOCIATION: Ural'skiy filial AN SSSR (Ural Branch, AS USSR)

SUBMITTED: June 15, 1960

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BARBASHIN, YE. A.

"Construction of periodic motion as one of the problems of programming control theory."

Paper presented at the Intl. Symposium on Nonlinear Vibrations, Kiev, USSR, 9-19 Sep 61

Urals Polytechnical Institute, Sverdlovsk

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AUTHORS: Barbashin, Ye.A., and Alimov, Yu.I.

TITLE: On the theory of dynamic systems with discontinuous and no single-valued characteristics

PERIODICAL: Akademiya nauk SSSR. Doklady, v.140, no. 1, 1961, 9-11

TEXT: It is shown that in certain cases the investigation of differential equations with ambiguous right sides can be reduced to the investigation of equations defined in certain linear normed spaces and the right sides of which are unique. Let R be an n-dimensional Euclidean space, let S be a closed Euclidean sphere, let γ be a unique mapping of S into R. Here the image of S is called an S-set. Let M(R) be the complete Banach space of all measurable essentially bounded γ with the norm $\| \gamma \| = \operatorname{vrai\,max}_{p \subset S} \| \gamma(p) \|_R$.

Let f(p) be an ambiguous function defined on the m-dimensional Euclidean space E and the values of which are certain S-sets of R. To the function f(p) the authors adjoin a unique function F(p) the values of which lie

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in $M(R)$; $F(p) = \gamma$ if $\gamma(S) = f(p)$. $f(p)$ is called continuous if $F(p)$ is continuous. The other notions of the descriptive theory of functions are transferred to the ambiguous functions in an analogous manner. Let $f_n(p)$ converge almost uniformly to $f(p)$ on $E' \subset E$ if for arbitrary $\varepsilon > 0$, $\delta > 0$ there exists a set $E_\varepsilon \subset E'$, mes $E_\varepsilon < \varepsilon$ and there exists a positive number $n(\delta)$ so that $\| F_n(p) - F(p) \|_{M(R)} < \delta$ holds for all $p \subset E' \setminus E_\varepsilon$ and $n > n(\delta)$. The function $f(p)$ is called countable-valued on E' if $F(E')$ is a countable set, where the inverse images of the points of $M(R)$ are measurable sets for the mapping $F(p)$ of E into $M(R)$. $f(p)$ is called measurable if there exists a sequence of countable-valued functions $f_n(p)$ converging almost uniformly on E' with respect to $f(p)$.

The integral of a measurable $f(p)$ is defined by

$$\int_{E'} f(p)dp = (B) \int_{E'} F(p)dp$$

where (B) denotes a Bochner - integral. Let E be the number line. The

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The derivative of an ambiguous $f(t)$, $t \subset E$, is defined by

$$\frac{df(t)}{dt} = \lim_{h \to 0} \frac{f(t+h) - f(t)}{h}$$

where the limit value corresponds to the metric introduced above. Given the differential equation

$$\dot{x} = f(t,x) \qquad (1)$$

where $f(t,x)$ is an ambiguous function defined for $x \subset R$, $-\infty < t < +\infty$ (the set $f(t,x)$ is an S-set of R). Let the condition (A) be satisfied : If X is an S-set of R then $f(t,x)$ is an S-set too (here $f(t,X) = \bigcup_{x \subset X} f(t,x)$) .

Beside of (1) the authors consider

$$\frac{dX}{dt} = f(t,X) \quad , \qquad (2)$$

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The solutions of (2) are ambiguous functions X(t) of the scalar argument t with values being S-sets of R. In the initial moment the trajectories of (2) are fixed by S-sets of R and are tubes in R. If X and f(t,X) are not considered as S-sets of R but as elements of M(R) then (2) becomes an equation with an ambiguous right side to which the theory of differential equations in Banach spaces is applicable.

There are 7 Soviet-bloc and 4 non-Soviet-bloc references. The reference to the English-language publication reads as follows: E. Hill, Funktsional'nyy analiz i polugruppy (Functional analysis and semigroups) M., 1951.

ASSOCIATION: Ural'skiy filial Akademii nauk SSSR (Ural Branch of the Academy of Sciences USSR)

PRESENTED: April 21, 1961, by L.S. Pontryagin, Academician

SUBMITTED: April 20, 1961

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C111/C222

AUTHORS: Serebryakova, V.S., and Barbashin, Ye.A.

TITLE: A qualitative investigation of the equations describing the motion of mutually influencing points on the circle

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Matematika, no.2, 1961, 137-146

TEXT: The points P and Q with the masses m_1 and m_2 and the angular coordinates x and y move on the circle under the influence of the forces $m_1 f(x)$ and $m_2 f(x)$, the frictional forces $m_1 R_1(x, \dot{x})$ and $m_2 R_2(y, \dot{y})$ and the mutual force of attraction $\mu \psi(y-x)$. The motion equations read

$$\begin{cases} \dot{x} = u, \\ \dot{u} = -R_1(x,u) - f(x) + k_1 \psi(y-x), \\ \dot{y} = v, \\ \dot{v} = -R_2(y,v) - f(y) - k_2 \psi(y-x), \end{cases} \qquad (2)$$

where $k_i = \frac{\mu}{m_i}$ $(i=1,2)$. It is assumed:

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a) $f(\eta)$, $\Psi(z)$, $R_1(x,u)$, $R_2(y,v)$ are everywhere continuous and in the neighborhood of the singular places of (2) they have continuous partial derivatives; $f(\eta+2\pi) = f(\eta)$, $\Psi(z+2\pi) = \Psi(z)$; $R_1(x+2\pi,u) = R_1(x,u)$; $R_2(y+2\pi,v) = R_2(y,v)$.

b) $f(\eta_1) = f(\eta_2) = f(0) = 0$, where $\eta_1 > 0$, $\eta_2 < 0$ are the zeros of $f(\eta)$ being nearest to $\eta = 0$, and $\eta_1 - \eta_2 = 2\pi$. It holds $\eta f(\eta) \geqslant 0$ in the neighborhood of $\eta = 0$ and

$$\int_0^{2\pi} f(\eta)d\eta < 0, \quad f'(0) \neq 0, \quad f'(\eta_1) \neq 0, \quad f'(\eta_2) \neq 0.$$

c) $R_1(x,0) = R_2(y,0) = 0$, $R_1(x,u)$ increasing in u, $R_2(y,v)$ increasing in v; for sufficiently large $|u|, |v|$:

$$(f(x)+R_1(x,u))u > 0$$
$$(f(y)+R_2(y,v))v > 0.$$

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d) $\psi(z) = -\psi(-z)$, $z\,\psi(z) > 0$ in the neighborhood of $z = 0$; k_1, k_2 -- sufficiently small; $|\psi(z)| \leq 1$.

The authors investigate regions of entry of the positions of equilibrium, possible types of motions, criteria for different qualitative courses in the phase planes (x,u) and (y,v), where (2) is replaced by

$$\frac{du}{dx} = \frac{-R_1(x,u) - f(x) + k_1\,\psi(y-x)}{u},$$

$$\frac{dv}{dy} = \frac{-R_2(y,v) - f(y) - k_2\,\psi(y-x)}{v}. \qquad (5)$$

It is stated that (2) has the singular points $O(0,0,0,0)$, $M_1(\gamma_1,0,\gamma_1,0)$, $M_2(\gamma_2,0,\gamma_2,0)$, $M_3(\gamma_1,0,\gamma_2,0)$, $M_4(\gamma_2,0,\gamma_1,0)$, where O is asymptotically stable, the other points, however, are instable of the saddle type. (2) has no limit cycles since the Lyapunov function

$$V = T + \Pi = \frac{m_1u^2 + m_2v^2}{2} + m_1\int_0^x f(x)\,dx + m_2\int_0^y f(y)\,dy + \mu\int_0^{y-x}\psi(z)\,dz \qquad (4)$$

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has a non-positive derivative $\frac{dV}{dt} \leq 0$. For investigating the integral curves of the first equation (5) the authors consider the auxiliary equations

$$\frac{du^-}{dx} = \frac{-R_1(x,u)-f(x)-k_1}{u}, \tag{7}$$

$$\frac{du^+}{dx} = \frac{-R_1(x,u)-f(x)+k_1}{u}, \tag{8}$$

so that the inequalities

$$\frac{du^-}{dx} \leqslant \frac{du}{dx} \leqslant \frac{du^+}{dx} \quad \text{for } u \geqslant 0,$$

$$\frac{du^+}{dx} \leqslant \frac{du}{dx} \leqslant \frac{du^-}{dx} \quad \text{for } u < 0 \tag{9}$$

are valid. With the aid of the monotony curves (Ref.3: V.A.Tabuyeva, K voprosu o forme oblasti prityazheniya nulevogo resheniya differentsial'-nogo uravneniya $\ddot{x} = f(x,\dot{x})$ [On the question on the form of the region of entry of the zero solution of the differential equation $\ddot{x} = f(x,\dot{x})$],

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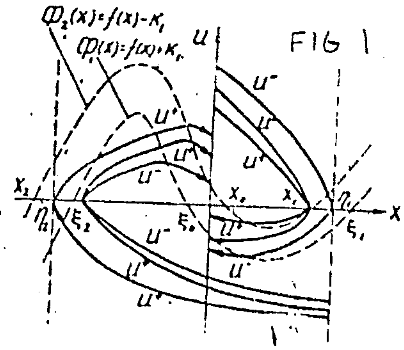
(figure 1)



the directional field of the integral curves of the first equation (5) as well as the equations (7),(8) is obtained. The mutual situation of the integral curves u of (5), u^+ of (8) and u^- of (7) going through a point is fixed by (9). The figures 2 and 3 show two types of phase images (figure 2 -- first type; figure 3 -- second type).

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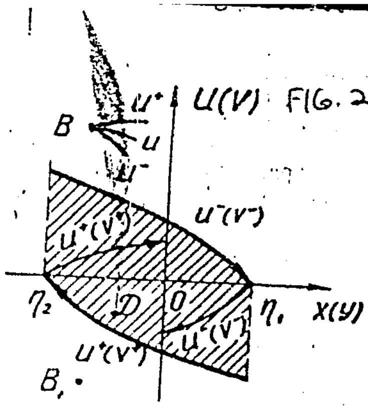

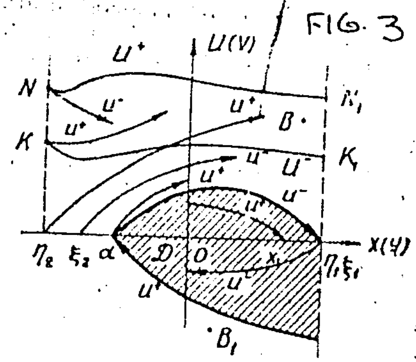

Theorem 1: If the point A lies in the strip $\eta_2 \leq x \leq \eta_1$, $\eta_2 \leq y \leq \eta_1$ of the phase space and if at least one of its projections onto the planes (xu) and (yv) does not lie in the corresponding region D then A cannot be attracted to the stable position of equilibrium (0,0,0,0) without leaving the region $x \leq \eta_1$, $y \leq \eta_1$.

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Case 1: Phase images in (x,u) and (y,v) are of the first type.
Case 2: Phase images in (x,u) and (y,v) are of different types.
Case 3: Phase images in (x,u) and (y,v) are of the second type.
In the case 1, P and Q may carry out fading oscillations around the position of equilibrium. In the case 2, P may carry out a circular motion (rotating), and Q fading oscillations around the position of equilibrium (theorem 2). In the case 3, both points may rotate (theorem 3).
Let

$$u_0 = \sqrt{2\int_x^{x_0} f(x)\,dx}; \qquad u_1 = u_0 + \int_x^{x_0} \frac{R_1(x, u_0) + k_1}{u_0(x)}\,dx;$$

$$z_0 = \sqrt{2\int_x^{x_0} [f(x) - k_1]\,dx}; \qquad z_1 = \sqrt{2\int_x^{x_0} [R_1(x, z_0) + f(x) - k_1]\,dx};$$

$$v_0 = \sqrt{2\int_y^{y_0} f(y)\,dy}; \qquad v_1 = v_0 + \int_y^{y_0} \frac{R_2(y, v_0) + k_2}{v_0(y)}\,dy;$$

$$r_0 = \sqrt{2\int_y^{y_0} [f(y) - k_2]\,dy}; \qquad r_1 = \sqrt{2\int_y^{y_0} [R_2(y, r_0) + f(y) - k_2]\,dy}.$$

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Let the system (2) satisfy the conditions a,b,c,d; let exist $z_1(x)$ for $\eta_2 < x \leq 0$ and $r_1(y)$ for $\eta_2 < y \leq 0$, let the function $\frac{R_1(x,u)+f(x)+k_1}{u}$ be non-increasing in u for $0 \leq u < \infty$ and $0 \leq x \leq \eta_1$; let the function $\frac{R_2(y,v)+f(y)+k_2}{v}$ be non-increasing in v for $0 \leq v < \infty$ and $0 \leq y \leq \eta_1$. Let A be the maximal ordinate of the points of $R_1(x,u)+f(x)-k_1 = 0$, and let B be the maximal ordinate of $R_2(y,v)+f(y)-k_2 = 0$. Then it holds (theorem 4):

a) from $u_o(0) > A$ it follows $u^-(0) > u^+(0)$,

b) from $v_o(0) > B$ it follows $v^-(0) > v^+(0)$,

c) from $u_1(0) < z_1(0)$ it follows $u^+(0) > u^-(0)$,

d) from $v_1(0) < r_1(0)$ it follows $v^+(0) > v^-(0)$.

Conclusions: a)+b) is sufficient for the appearance of the first case;

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c)+d) for the third case; a)+d) or b)+c) for the second case.
There are 4 figures and 5 Soviet-bloc references.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S. M. Kirova (Ural Polytechnical Institute im S. M. Kirov)
Ural'skiy filial AN SSSR (Ural Branch of the Academy of Sciences USSR)

SUBMITTED: March 22, 1960

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AUTHORS: Serebryakova, V. S. and Barbashin, Ye. A.

TITLE: On circular motions of connected pendula. II

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Matematika, no. 4, 1961, 112-118

TEXT: The authors investigate the motion of two pendula fastened on a fixed axis with the consideration of the frictional force between the pendula in the point of suspension. The motion equations read

$$\begin{cases} \dot{\psi} = x, \\ \dot{x} = -\alpha_1 x - \beta f(\psi) + \gamma_1 F(y-x), \\ \dot{\theta} = y, \\ \dot{y} = -\alpha_2 y - \beta f_1(\theta) - \gamma_2 F(y-x) \end{cases} \qquad (5)$$

where F is the frictional force related to the square of the length of the pendulum l, $F(-\omega) = -F(\omega)$, $F(0) = 0$, $F(\omega + 2\pi) = F(\omega)$; furthermore it holds $\beta = \frac{g}{l}$, $\gamma_i = \frac{1}{m_i}$, the α_i characteriz

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the resistance of the medium, f and f_1 are periodic functions;

$$f(\Psi) = \sin(\Psi + \varphi_1^0) - \frac{L_1}{\beta}; \quad f_1(\theta) = \sin(\theta + \varphi_2^0) - \frac{L_2}{\beta}$$

$L_i = \frac{r_i}{m_i l^2}$; r_i -- additional turing force acting onto the pendulum;

$\Psi = \varphi_1 - \varphi_1^0$; $\theta = \varphi_2 - \varphi_2^0$.

At first the authors consider the case $\left|F(\dot{\varphi}_2 - \dot{\varphi}_1)\right| \leq k$. From (5) the authors form $\frac{dx}{d\Psi}$ and $\frac{dy}{d\theta}$ and compare them with the comparison systems

$$\frac{dx^-}{d\Psi} = \frac{-\alpha_1 x - \beta f(\Psi) - k_1}{x}, \qquad (8)$$

$$\frac{dx^+}{d\Psi} = \frac{-\alpha_1 x - \beta f(\Psi) + k_1}{x}, \qquad (8')$$

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in the x, Ψ - plane and with

$$\frac{dy^-}{d\theta} = \frac{-\alpha_2 y - \beta f_1(\theta) - k_2}{y} \qquad (9)$$

$$\frac{dy^+}{d\theta} = \frac{-\alpha_2 y - \beta f_1(\theta) + k_2}{y} \qquad (9')$$

in the $y\,\theta$ - plane. The fact that $\frac{dx}{d\Psi}$ lies between $\frac{dx^-}{d\Psi}$ and $\frac{dx^+}{d\Psi}$ permits the following statement:

Theorem 1: If there exists an upper solution of (8) periodic in Ψ, and if $|L_1 \pm k_1| < \beta$, $k_1 = k\gamma_1 > 0$, or if there exists an upper solution of (9) periodic in θ, and if $|L_2 \pm k_2| < \beta$, $k_2 = k\gamma_2 > 0$, then one of the pendula performs a circular motion, i. e. for all t it holds $0 < a_1 < x(t) < b_1$ or $0 < a_2 < y(t) < b_2$.

Theorem 2 contains sufficient conditions that both pendula perform circular motions.

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Finally the authors consider the case where F means a dry friction; it is shown that the process can be obtained by a putting together of the phase curves of both continuous partial courses and that the theorems 1 and 2 preserve their correctness.

The authors mention N. N. Krasovskiy, V. V. Petrov, G. M. Ulanov, S. A. Chaplygin and M. J. Yel'shin. There are 7 Soviet-bloc references.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S. M. Kirova (Ural Polytechnical Institute im. S. M. Kirov) Ural'skiy filial AN SSSR (Ural Branch of the Academy of Sciences USSR)

SUBMITTED: July 28, 1960

Card 4/4

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

SEREBRYAKOVA, V.S.; BARBASHIN, Ye.A.

Authors' correction to the article "Qualitative investigation of equations describing the movement of interacting points on a circle". Izv.vys.ucheb.zav.; mat. no.5:127 '61. (MIRA 14:10)
(Equations) (Aggregates)

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye.A. (Sverdlovsk)

Programming control of systems with random parameters.
Prikl. mat. i mekh. 25 no.5:818-823 S-O '61. (MIRA 14:10)
(Automatic control)

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

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26766
S/103/61/022/006/001/014
D229/D304

3-2200 (1080, 1121, 1132)

AUTHOR: Barbashin, Ye.A. (Sverdlovsk)

TITLE: On the approximate realization of motion along a given trajectory

PERIODICAL: Avtomatika i telemekhanika, v. 22, no. 6, 1961, [redacted] 687

TEXT: A system of differential equations

$$\frac{dx_i}{dt} = f_i(x_1, \dots x_n, t) + {}_i(c_1, \dots c_k, y_1, \dots y_m, t) \qquad (1)$$

$$(i = 1, 2, \dots, n),$$

$(0 \leqslant t \leqslant T)$ and a trajectory $x_i = \psi_i(t)$ which does not generally satisfy (1) are considered. The problem consists in finding such parameters $c_1 \dots c_k$ or functions $y_1(t) \dots y_m(t)$ that the solu-

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tion $x_i(t)$ of (1) with initial conditions $x_i(0) = x_i^0$ is an approximation to the motion along the trajectory $x_i = \psi_i(t)$. The measure of approximation is the mean square value of the error, with which the given trajectory satisfies (1). The paper considers the possibility of such approximation if (1) is not linear and gives effective methods for solving the problem when the functions ψ_i are linear. (The parameters c_a can then be determined from a system of linear algebraical equations). There are 10 references: 9 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English-language publication reads as follows: I.L. Massera, On Lyapunov's condition of stability, Annals of Mathematics, vol. 50, no. 3, 1949.

SUBMITTED: December 12, 1960

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S/040/61/025/002/011/022
D201/D302

AUTHOR: Barbashin, Ye.A. (Sverdlovsk)

TITLE: On the construction of periodic motion

PERIODICAL: Prikladnaya matematika i mekhanika, v. 25, no. 2, 1961, 276 - 283

TEXT: The conditions are stated with which there is a possible set of initial signals of the system which approximately realize the periodic process. With real conditions the programming functions can only be given approximately. This article gives estimates of the permissible error of the programming functions. A system of differential equations

$$\frac{dx_i}{dt} = f_i(x_1, \ldots, x_n, t) + \varphi_i(t) \quad (i = 1, \ldots, n) \qquad (1.1)$$

is considered. Assuming that all the f_i are periodic functions of time t with period ω, (1.1) is soluble, the solution in the general

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case being of the form

$$\varphi_i(t) = \psi_i'(t) - f_i(\psi_1(t), \ldots, \psi_n(t), t) \quad (i = 1,\ldots n). \quad (1.2)$$

However, if in practice $x_i = \psi_i(t)$ determine some programming regime, then this regime will exist in reality, only if it is stable with respect to the initial disturbances. Hence (1.2) can only be satisfied approximately with some error. The question of the existence, conservation and stability of periodic motion with a bounded modulus of external forces is approached by the basic method of Lyapunov functions. For approximate periodic motion Γ, the following properties occur: 1) All trajectories beginning with $t = t_0$ in a sufficiently small neighborhood of Γ, are contained in ε, the neighborhood of Γ, for $t > t_0$. 2) In ε there exists an asymptotic periodic motion whose region of definition lies in some neighborhood of Γ. Transforming the variable of (1.1) one obtains

$$\frac{dz_i}{dt} = Z_i(z_1, \ldots, z_n, t) + r_i(t) (i = 1,\ldots,n) \quad (2.1)$$

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On the construction of ... S/040/61/025/002/011/022 D201/D302

where

$$\frac{dz_i}{dt} = f(z_1 + \psi_1(t), \ldots, z_n + \psi_n(t), t) + \varphi_i(t) - \varphi_i'(t) \qquad (i = 1, \ldots, n)$$

$$Z_i(z_1, \ldots, z_n, t) = f_i(z_1 + \psi_1(t), \ldots, z_n + \psi_n(t), t) - f_i(\psi_1(t), \ldots, \psi_n(t), t)$$

$$r_i(t) = \varphi_i(t) - \psi_i'(t) + f_i(\psi_1(t), \ldots, \psi_n(t), t) \qquad (i = 1, \ldots, n)$$

Writing (2.1) in vector form gives

$$dz/dt = A(t)z + R(z, t) + r(t). \qquad (2.3)$$

If D is the region defined by $//z// \leqslant \varepsilon$, $0 \leqslant t < \infty$, it is assumed that in (2.3) then a) A(t), R(z, t), r(t) are periodic with respect to t and have period ω; b) R(z, t) satisfied the Lipshits conditions

$$//R(z, t) - R(y, t)// \leqslant L//z - y//, \quad z \in D, \ y \in D$$

in D; c) $\alpha_{ik}(t)$ and $R_i(z, t)$ (in the usual notation of components), for fixed z are absolutely integrable in the Lebeg sense in $[0, \omega]$, X

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d) Function $r_i^2(t)$ integrated in the Lebeg sense [Abstractor's note: Not stated] on $[0, \omega]$, e) There exists a fundamental matrix $W(t, \tau)$ of the system $z' = A(t)z$ satisfying $W(\tau, \tau) = E$, where E is the unit matrix and $//W(t, \tau)// \leqslant Be^{-\alpha(t-\tau)}$, $B \geqslant 1$, $\alpha > 0$; f) $\lambda = \alpha - LB > 0$. The case is then considered when $x_i = \psi_i(t)$ can have the total number of points of discontinuity of the first kind. Then the approximation programming function must be of the form

$$\varphi_i(t) = \psi_i'(t) - f_i(\psi_1(t), \ldots, \psi_n(t), t) \quad (i = 1, \ldots, n) \quad (3.1)$$

at the points where a derivative exists and

$$\varphi_i(t) = \eta_{ik}\delta(t - t_k) \quad (3.2)$$

at the points of discontinuity, where η_{ik} is the magnitude of the discontinuity at $t = t_k$, and $\delta(t - t_k)$ is Dirac's function. If $\varphi_i(t)$ is replaced by an approximation function of the same type,

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then the error of the approximation is obtained in the form

$$r_i(t) = r_i^{\circ}(t) + \sum_{k=1}^{m} r_{ik}\delta(t - t_k) \qquad (i = 1, \ldots, n) \tag{3.3}$$

where $r_i^0(t)$ is absolutely integrable in $[0, \omega]$. It is shown that in this case A(t) and R(t) may be expressed in terms of the discontinuity functions. Theorem: Let conditions a), b), c), d), e), f) be satisfied and the functions $r_i(t)$ be of the form (3.3). Let $\delta = \varepsilon/2B$ and let

$$\rho_1 = \int_0^{\omega-0} \rho(t)\,dt = \int_0^{\omega} \rho^{\circ}(t)\,dt + \sum_{k=1}^{m} \gamma_k < \frac{\varepsilon}{2B^2} e^{-\lambda\omega}(1 - e^{-\lambda\omega})$$

hold. Then both assetions of the previous theorem are fulfilled. This theorem may also be formulated for the more general case when the programming functions have limited variation. In this case

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On the construction of ...

$$z(t) = W(t, t_0) z_0 + \int_{t_0}^{t} W(t, \tau) R(z, \tau) d\tau + \int_{t_0}^{t} W(t, \tau) dG$$

should be considered, where the second integral is the integral of Stil't'yes with integrating functions $G(t)$ $(G_1(t) \ldots G_n(t))$ having bounded variation. This may be reduced to the preceding case by means of a function $r_i(t) = G_i'(t)$. A still more general approach is possible on the basis of the generalized differential equation introduced on the basis of Ya. Kurtsveyl's generalization of Perron's integral. Let

$$\rho(t) = \|r(t)\|, \quad h_0 = \sup_{0<t<\infty} \rho(t)$$

$$h_1 = \sup_{0<t<\infty} \int_{t}^{t+\omega} \rho(t)\, dt, \quad h_2 = \sup_{0<t<\infty} \left(\int_{t}^{t+\omega} \rho^2(t)\, dt \right)^{1/2}$$

where ω is an arbitrary positive number. Then part of the above

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On the construction of ... S/040/61/025/002/011/022
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results may be applied to the case when (1.1) and the programming functions are not periodic. Theorem: Let b), c), d), e), f) be fulfilled (with the difference that the corresponding functions must be integrable in any interval, $[t, t + \omega]$, $t > 0$) and at least 1 of

$$(A') \quad h_0 < \frac{\varepsilon}{2B}\lambda$$

$$(B') \quad h_1 < \frac{\varepsilon}{2B} e^{-\lambda\omega}(1 - e^{-\lambda\omega})$$

$$(C') \quad h_2 < \frac{\varepsilon}{2B}\left(\frac{2\lambda}{e^{2\lambda\omega} - 1}\right)^{1/2}(1 - e^{-\lambda\omega})$$

is fulfilled. Then every solution $z(t)$ of (2.3) defined by $//z(0)// \leqslant \varepsilon/2B$ lies entirely within D for $t \geqslant 0$. In conclusion the case of an approximation (non-periodic) motion with isolated discontinuities is considered. There are 14 references: 12 Soviet-bloc and 2 non-Soviet-bloc. The references to the English-language publications read as follows: H.A. Antosiewicz, Forced periodic solutions of systems of differential equations, Ann., Math., 1953,

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On the construction of ...

vol. 57, no. 2; and J.Z. Massera, T.T. Schäffer, Zinear (sic) differential equations and functional analysis, I. Ann. Math., 1958, vol. 57, no. 3.

SUBMITTED: January 30, 1961

Card 8/8

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

34760

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S/140/62/000/001/001/011
C111/C444

AUTHORS: Barbashin, Ye. A., Alimov, Yu. I.

TITLE: On the theory of Relais differential equations

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Matematika, no. 1, 1962, 3-13

TEXT: The paper contains a representation of the main results of (Ref. 12: S. Ch. Zaremba. Sur les équations au paratingent. Bull. sci. math. 2 ser., v. 60, p. 139, 1936) and of (Ref. 13: A. Marchaud. Sur les champs continus de démi-cônes convexes et leurs integrales. Compositio math., v. 3, f. 1, p. 89, 1936) and some new theorems which the authors assume to be fit for the investigation of relais controls. The following notations are used $x = (x_1, \ldots, x_n)^*$; $f(t, x) = (f_1(t, x), \ldots, f_n(t, x))^*$; the star indicates the transposed matrix. A mapping of $p \in E_m$ on a connected compact $\{f(p)\}$ of an n-dimensional space $E(f)$ of the $f_1, f_2, \ldots, f_n$ is called an n-dimensional multi-valued vector function $f(p)$. The notion of contingence kont $x(t)$ of

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On the theory of Relais differential ... C111/C444

$y = \varphi(t)$ in $t = t_0$ is introduced as usual. All integrals and measures are understood in the sense of Lebesgue.

Considered is the equation

$$\dot{x} = f(t, x) \qquad (1)$$

where $f(t, x)$ is an n-dimensional multivalued function; the equation is understood as an equation in contingences. $S(G, \varepsilon)$ denotes the ε-neighborhood of the set G. $\varrho(A, B)$ denotes the distance of the sets A and B; $\beta(A, B) = \sup_{X \subset A} \varrho(X, B) = \inf_{A \subset S(B, \varepsilon)} \varepsilon$; $\alpha(A, B) = \max(\beta(A, B), \beta(B, A))$. One calls $f(p)$ α- continuous in $R(p) \subset E_n$, if for every $p_0 \in R(p)$ and for every $\varepsilon > 0$ there exists a $\delta = \delta(p_0, \varepsilon) > 0$ such that $\alpha(\{f(p)\}, \{f(p_0)\}) < \varepsilon$ for all $p \in R(p)$ for which $\varrho(p, p_0) < \delta$.

The β- continuity is defined analogously.

Theorem 1 says that an $f(p)$, β- continuous in the bounded domain $\bar{R}(p)$ is bounded in that domain.

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On the theory of Relais differential ... S/140/62/000/001/001/0..
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Theorem 2: If $f(t, x)$ is β - continuous with respect to t and x in the bounded domain $\bar{G}(t,x)$, then all solutions of (1) satisfy the Lipschitz-condition in $\bar{G}$ with respect to t with the common constant L.

The equation (1) is said to satisfy the condition A on $G = G(t, x)$, if $f(t, x)$ is defined in every point of G, and β - continuous with respect to t, x, and if $\{f(t, x)\}$ in the space $E(f)$ is convex.

Theorem 3 says that in case (1) satisfies the condition A in G, then there exists to every interior point (t_0, x_0) in G at least a solution of (1) passing through (t_0, x_0).

Theorem 4 says that in case (1) satisfies the condition A in $\bar{G}(t, x)$, $x(t)$ is solution of (1) on $t_1 \leq t \leq t_2$ if and only if

$$(t, x(t)) \subset G(t, x), \tag{9}$$

$$x(t'') = x(t') + \int_{t'}^{t''} \varphi(\xi)\, d\xi \tag{10}$$

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On the theory of Relais differential ... S/140/62/000/001/001/011
C111/C444

$$\varphi(t) \in \{ \Phi(t, x(t)) \}$$ (1')

are satisfied for all t, t', t" $\in [t_1, t_2]$.

The theorems 6 and 7 establish the possibility of the variable transformations $t = t(\tau)$ and $y = \psi(t, x)$ for (1).

Theorem 8 is an analogue of the theorem of Wintner (Ref. 18: The infinities of the nonlocal existence problem of ordinary differential equations. Amer. J. Math., v. 68, 1946) on the possibility of continuation of the solutions.

Theorem 9 is a statement on the continuous dependence of the solutions on the initial conditions and on the right hands.

In theorem 10 one considers the mapping, given by an autonomous system $\dot{x} = f(x)$.

There are 14 Soviet-bloc and 4 non-Soviet-bloc references. The reference

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[illegible] theory of [illegible] differential ... S/140/6?/000/00?/00?/0?? C111/C444

[illegible] English-language publications reads as follows: A. Wintner. The [illegible] of the nonlocal existence problem of ordinary differential equations. Amer. J. Math., v. 68, 1946

ASSOCIATION: Ural'skiy gosudarstvennyy universitet im. A. M. Gor'kogo, Ural'skiy filial AN SSSR (Ural State University im. A. M. Gor'kiy, Ural Subsidiary of the Academy of Sciences [illegible] SSSR)

SUBMITTED: September 30, 1960

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

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D201/D308

16,8000

AUTHORS: Barbashin, Ye. A. and Tabuyeva, V. A. (Sverdlovsk)

TITLE: A method of stabilizing a third-order control system with high gain. I

PERIODICAL: Avtomatika i telemekhanika, v. 23, no. 10, 1962, 1290-1297

TEXT: The authors analyze a linear switching condition for a third-order positive-negative feedback control system. An expression for the linear switching condition is derived which, provided the gain is large enough, results in an asymptotic stability of the general solution of the third-order differential equation describing the system, all motion being changed into slip. The analysis shows that after going over into slip the rate of attenuation of the process is proportional to the coefficient B of the first derivative of the equation determining the law of change of the variable gain element. It is shown that when the coefficient B has its optimum value the

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye. A.

"Programmed Control and Theory of Optimum Systems."

Paper to be presented at the IFAC Congress held in Basel, Switzerland, 27 Aug to 4 Sep 63

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

L 13068-63 EWT(d)/FCC(w)/BDS AFFTC Pg-4 IJP(C)

ACCESSION NR: AP3000948 S/0140/63/000/003/0003/0014

AUTHOR: Barbashin, Ye. A.; Bisyarina, L. P. (Sverdlovsk) 57

TITLE: Stability of solutions of integro-differential equations 16 16

SOURCE: IVUZ. Matematika, no. 3, 1963, 3-14

TOPIC TAGS: integro-differential equation, stability, exponential law stability, constantly operating perturbation, dissipative stability

ABSTRACT: The authors give several definitions of stability of solutions of integro-differential equations and formulate various theorems yielding sufficient conditions for such stability. The definitions and a typical theorem are given in the enclosures. Orig. art. has: 84 formulas.

ASSOCIATION: none

SUBMITTED: 09Apr62 DATE ACQ: 12Jun63 ENCL: 03

SUB CODE: 00 NO REF SOV: 004 OTHER: 000

Card 1/4

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7"

"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

ACCESSION NR: AT4017763 S/3037/63/003/000/0034/0040

AUTHOR: Barbashin, Ye. A. (USSR)

TITLE: The construction of periodic motion as one of the problems of the theory of programmed control

SOURCE: International Symposium on Nonlinear Oscillations. Kiev, 1961. Prilozheniya metodov teorii nelineyny*kh kolebaniy k zadacham fiziki i tekhniki (Applying methods of the theory of nonlinear oscillations in problems of physics and technology); trudy* simpoziuma, v. 3. Kiev, Izd-vo AN UkrSSR, 1963, 34-40

TOPIC TAGS: automation, feedback, control system, programmed control, periodic motion, nonperiodic motion, programming

ABSTRACT: The author considers the conditions under which it is possible to select the input signal of a system in order that the prescribed periodic process may be approximately realized. The problem considered has a bearing on the theory of programming control, since it involves the question of the feasibility of finding programming functions to provide a stable periodic programmed condition. Under real conditions, programming functions may be prescribed only in an approximate manner. The author furnishes estimations of permissible errors in the setting of the programming functions. From a

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purely mathematical point of view, the problem resolves itself to the formulation of the conditions governing the maintenance and stability of the periodic motion in the face of permanent disturbances, limited in the norm: The absolute value, mean absolute value and mean-square value of the aforementioned permissible error are given. A case is considered in which the periodic motion to be constructed is discontinuous. A part of the fundamental results are extended to a case in which nonperiodic motion is to be approximated. Three theorems are advanced in the paper. Orig. art. has: 8 formulas.

ASSOCIATION: None

SUBMITTED: 00 DATE ACQ: 28Feb64 ENCL: 00

SUB CODE: CG NO REF SOV: 009 OTHER: 003

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

S/103/63/024/001/002/012
D201/D308

AUTHORS: Barbashin, Ye. A., Pechorina, I. N. and Eydinov, R. M. (Sverdlovsk)

TITLE: Variable structure automatic regulators in the control of a certain class of linear static objects

PERIODICAL: Avtomatika i telemekhanika, v. 24, no. 1, 1963, 27-32

TEXT: The authors consider the possibility of applying an automatic control system with variable structure given by S. V. Yemel'yanov (Avtomatika i telemekhanika, v. 20, no. 7, 1959) to the control of objects in which the static error is essential for the compensation of disturbances and the parameters of which vary within sufficiently wide limits. The theoretical analysis of the second order 'switch' type system is given and experimentally investigated in a system in which the static error operates a relay after passing through a 'switch' type network. This relay responds to the sign of the error transducer and changes the sign of the gain of the system. The experimental analysis of this system with step- and

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Variable structure automatic ...

slow-varying inputs, limited in amplitude, shows that provided the parameters of the system have been properly chosen Yemol'yanov's expression can be successfully used for high quality regulation. The experiments havw also shown that the system's performance remains satisfactory even when the gain varies considerably during its period of operation. There are 8 figures.

SUBMITTED: March 29, 1962

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

L 23862-65 EWT(1) IJP(c)

ACCESSION NR: AR4046306 S/0044/64/000/008/B043/B043

SOURCE: Ref. zh. Matematika, Abs. 8B240

15

AUTHOR: Barbashin, Ye. A.

TITLE: Constructing periodic motion as one of the problems of the theory of programming regulation

21

CITED SOURCE: Tr. Mezhdunar. simpoziuma po nelineyn. kolebaniyam, 1961. T. 3, Kiyev, AN USSR, 1963, 30-40

TOPIC TAGS: periodic motion, program regulation, differential equation, periodic function, programming condition, operating disturbance, admissible error of approximation, asymptotic stable periodic motion, none periodic motion

TRANSLATION: For the system of differential equations

$$\frac{dx_i}{dt}=f_i(x_1,\ldots,x_n,t)+\varphi_i(t),\ i=1,\ldots,n,$$

where $f_i(x_1,\ldots,x_n,t)$ are periodic functions of the time t with period ω, a problem may be set up of selecting such periodic functions $\varphi_i(t)$ that the given system of

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ACCESSION NR: AR4046306

periodic functions $x_i = \psi_n(t)$ of period ω represents the solution of the initial system. The solution of this simple problem

$$\varphi_i(t) = \psi_i'(t) - f_i(\psi_1(t), \ldots, \psi_n(t), t), \quad i = 1, \ldots, n,$$

may prove incovenient, for the programming condition $\psi_i(t)$ will really exist only if it is stable with respect to the initial disturbance and with respect to the continuously operating disturbances. Besides, under real conditions the programming functions $\varphi_i(t)$ can be given approximatively. The paper contains simple estimates of the absolute, mean and root-mean-square values of the admissible error of approximation of the programming functions for which the approximated periodic motion $\psi_i(t)$ will have the following properties: (1) all trajectories starting at $t = 0$ with a sufficiently low velocity G will not exit from the ε-neighborhood G if $t \geq 0$; (2) in the ε-neighborhood of G there exists an asymptotic stable periodic motion whose gravity region contains some neighborhood G. The author examines the case where the programming solution $x_i = \psi_i(t)$ can have a finite number of points of discontinuity of the first kind. Part of the basic results is applied to the case of non-periodic approximated motion. F. Ereshko

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Card 2/2

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L 51850-65

ACCESSION NR: AR4046571 S/0271/64/000/008/A027/A027
62.501.3

SOURCE: Ref. zh. Avtomat., telemekh. i vychisl. tekhn. Svodnyy tom, Abs. 8A181

AUTHOR: Barbashin, Ye. A.

4
B

TITLE: Constructing the periodic motion as a problem of the theory of program control

CITED SOURCE: Tr. Mezhdunar. simpoziuma po nelineyn. kolebaniyam, 1961. T.3. Kiyev, AN USSR, 1963, 34-40

TOPIC TAGS: periodic motion, program control

TRANSLATION: For a set of differential equations

$$\frac{dx_i}{dt} f_i(x_1, \ldots, x_n, t) + \varphi_i(t) \quad i=1, \ldots, n,$$

where $f_i(x_1,\ldots,x_n, t)$ are the periodic functions of time t with a period ω, a problem can be formulated to select such periodic functions $\varphi_i(t)$ that the specified set of periodic functions $x_i = \psi_i(t)$ of the period ω be a solution

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of the initial function. The solution of this simple problem $\varphi_i(t) = \psi_i'(t) - f_i(\psi_1(t), \ldots, \psi_n(t), t)$ may not be suitable because the programmed conditions $\psi_i(t)$ would exist only in the case of stability with respect to initial and continuous disturbances. Besides, under real conditions the programming functions $\varphi_i(t)$ may be defined approximately. Simple evaluations of the absolute, mean, and mean-square values of the permissible error of approximating the programming functions are obtained; with these values, the periodic motion to be approximated has the following characteristics: (1) all paths that start at $t = 0$ within a sufficiently small neighborhood Γ do not leave, at $t > 0$, the ε-neighborhood of Γ; (2) in the ε-neighborhood of Γ, an asymptotically stable periodic motion exists whose gravitational region includes the neighborhood Γ. The programmed solution $x_i = \psi_i(t)$ may have a finite number of first-kind discontinuities. A part of the principal results may be extended over the case of an approximatable nonperiodic motion.

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

L 9890-63 BDS
ACCESSION NR: AP3000464 S/0103/63/024/005/0608/0614

AUTHOR: Barbashin, Ye. A.; Tabuyeva, V. A. (Sverdlovsk) 46

TITLE: Method for stabilizing a third-order high-amplification control system - 2

SOURCE: Avtomatika i telemekhnika, v. 24, no. 5, 1963, 608-614

TOPIC TAGS: stabilizing control systems, automatic control

ABSTRACT: It was shown by the same authors (the same title, part 1, Avtomatika i telemekhanika, vol 23, no 10, 1962) that a certain rule for changing the sign of the amplification factor, in a third-order control system, secures the system-operation stability. The present article tries to prove that the same rule can also be used for increasing the dynamic accuracy of a follow-up system. The amplification-factor sign depends on the magnitude of error and on its first and second derivaties. Experimental verification, on a model, done by R. M. Eydinov showed good performance for both a sudden and a gradually varying signals. Orig. art. has: 14 equations and 2 figures.

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L 18404-63 EWT(d)/BDS AFFTC/ASD/APGC/IJP(C) Pg-4/Pk-4/Pl-4/Po-4/
Pq-4 BC

ACCESSION NR: AP3003735 S/0103/63/024/007/0882/0890

AUTHOR: Barbashin, Ye. A. (Sverdlovsk); Tabuyeva, V. A. (Sverdlovsk); Eydinov, R. M. (Sverdlovsk)

TITLE: Stability of a variable control system upon a disturbance in the sliding conditions

SOURCE: Avtomatika i telemekhanika, v. 24, no. 7, 1963, 882-890

TOPIC TAGS: variable control system, third order control system, control system disturbance, MN-M model

ABSTRACT: Conditions of asymptotic stability of a third-order automatic-control system upon a sudden disturbance were investigated in previous (referenced) papers. Experiments staged by R. M. Eydinov showed that a disturbance in the sliding conditions does not impair the quality of control; in a certain sense, the disturbance may even improve it. The present article offers theoretical and experimental substantiation for the stability of the above system when sliding

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ACCESSION NR: AP3003735 3

conditions are disturbed. A third-order differential equation describing the transients in the control system is considered, and the case of a jump disturbance is discussed. An auxiliary theorem is formulated and proved. Results of the theoretical study were verified on a sort of experimental kit (MN-M model) that included 3 inertial units, 2 amplifiers, a summation unit, and an inverter. Oscillograms given in the article are evidence that a disturbance in sliding conditions, within certain limits, does not affect the quality of automatic control. Hence, the correction method is offered for the automatic control systems whose parameters vary in time. "The authors are thankful to I. N. Pechorina for her comments regarding their work." Orig. art. has: 5 figures and 15 formulas.

ASSOCIATION: none

SUBMITTED: 01Oct62	DATE ACQ: 02Aug63	ENCL: 00
SUB CODE: IE	NO REF SOV: 003	OTHER: 000

Card 2/2

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L 18093-63 EWT(d)/FCC(w)/BDS AFFTC/IJP(C)
~~ACCESSION NR:~~ AP3004112 S/0040/63/027/004/0664/0671
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AUTHORS: Barbashin, Ye. A.; Tabuyeva, V. A. (Sverdlovsk)

TITLE: Theorem on stability of the solution of a third order differential equation with discontinuous characteristic 16

SOURCE: Prikladnaya matematika i mekhanika, v. 27, no. 4, 1963, 664-671

TOPIC TAGS: differential equation, stability, control system

ABSTRACT: The author considers the differential equation (1)

$$\dddot{x} + F(x, \dot{x}, \ddot{x}, t) + Kx \operatorname{sign} [x(\ddot{x} - \varphi(x, \dot{x}))] = 0 \qquad (1)$$

where k is a positive constant, the function F is continuous in all arguments so long as $t \geq 0$, is bounded in t for the other arguments fixed, and has all first partials continuous in all arguments. The function φ is continuous with first and second partial derivatives piecewise continuous in all arguments. It is also assumed that (a)

$$\text{(a)} \quad |\rho^2 F(x, y/\rho, z/\rho^2, t\rho)| < A(x, y, z); \qquad |\rho\varphi(x, y/\rho)| < B(x,y)$$

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for sufficiently small values of the parameter ρ where A and B are assumed to be continuous functions of their arguments, and (b)

$$\text{(b)}\quad \varphi(0,0)=0,\ \varphi(x,0)x<0 \text{ for } x\neq 0,\quad |\varphi(x,y)-\varphi(x,0)|y<0 \text{ for } y\neq 0,\quad \int_{\pm\infty}^{0}\varphi(x,0)\,dx=\infty$$

The basic result of this article is the following:
Theorem. Let (a) and (b) be satisfied and $\varepsilon > 0$ be given. Then for any given bounded region G of the phase space, of points $(x(t), \dot{x}(t), \ddot{x}(t))$, it is possible to find $k_0 > 0$ such that when $k \geq k_0$ and solution of (1) defined by the initial data from G will satisfy from some time on the condition $|x(t)| < \varepsilon$, $|\dot{x}(t)| < \varepsilon$, $|\ddot{x}(t)| < \varepsilon$. Orig. art. has: 17 formulas and 1 diagram.

ASSOCIATION: Sverdlovskoye otdeleniye Matematicheskogo in-ta AN SSSR (Sverdlovsk Branch of Mathematics Institute, Academy of Sciences, SSSR)

SUBMITTED: 18Mar63 DATE ACQ: 15Aug63 ENCL: 00

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

BARBASHIN, Ye.A.; TABUYEVA, V.A.; EYDINOV, R.M. (Sverdlovsk)

"Stability of the variable automatic control systems"

report presented at the 2nd All-Union Congress on Theoretical and Applied Mechanics, Moscow, 29 January - 5 February 1964

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ACCESSION NR: AP4028983 S/0280/64/000/002/0121/0128

AUTHOR: Badkov, V. M. (Sverdlovsk); Barbashin, Ye. A. (Sverdlovsk)

TITLE: Method of stabilizing a control system that has limited permissible values of the controller parameters

SOURCE: AN SSSR. Izvestiya. Tekhnicheskaya kibernetika, no. 2, 1964, 121-128

TOPIC TAGS: automatic control, third order automatic control, variable structure automatic control, time optimum automatic control, automatic control stabilization, limited controller parameter stabilization

ABSTRACT: A third-order variable-structure automatic-control system is examined. The problem of stabilizing such a system with certain limited permissible parameters of the controller is considered. Time-optimizing conditions are imposed; a law is found which not only effects stabilization of the (generally unstable) system, but also provides for a high quality of control. The

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corresponding switching surface consists of two planes discontinuous in the coordinate plane $x = 0$. The desirable control quality is achieved by varying the slip of a phase-space point moving over the switching surface. An extensive supplement contains the proofs of various theorems used in the article. Orig. art. has: 1 figure and 36 formulas.

ASSOCIATION: none

SUBMITTED: 08Aug63 DATE ACQ: 30Apr64 ENCL: 00

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ACCESSION NR: AP4046593 S/0030/64/000/009/0120/0121

AUTHOR: Barbashin, Ye. A. (Doctor of physico-mathematical sciences)

TITLE: Theory of control systems with variable structure

SOURCE: AN SSSR. Vestnik, no. 9, 1964, 120-121

TOPIC TAGS: control system, variable structure control system, Lyapunov function, mathematical model

ABSTRACT: A seminar on the theory of control systems with a variable structure was held in Sverdlovsk on May 22-25 at the Sverdlovskoye Otdeleniye Matematicheskogo instituta imeni V. A. Steklova (Sverdlovsk Division of the V. A. Steklov Mathematics Institute). The seminar was attended by specialists in mathematics and mechanics and engineers of a number of scientific establishments at Sverdlovsk, Moscow and Frunze. High quality of regulation is achieved in variable structure control systems by discontinuous changes in their parameters and structure. Systems of differential, difference and difference-differential equations with piecewise linear characteristics can be used as a mathematical model of a variable structure control system. The methods used in mathematical investigation of such systems were discussed in reports by Ye. A. Barbashin, Ye. I. Gerashchenko, V. I. Utkin and R. M. Eydinov. They discussed the stability of such systems, stressing

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the small-parameter and Lyapunov functions methods. S. V. Yemel'yanov summarized the results of work on methods of synthesis and investigation of such systems and the relationship between control systems with variable structure and other systems. M. A. Bermant reported on structural transformations in control systems with variable structure. M. V. Gritsenko discussed autonomy in multichannel systems of this class. V. A. Taran told of synthesis of control in the limited use of measured values. N. Ye. Kostyleva announced a new class of control systems with variable structure. S. S. Krasitskiy presented a paper on the principles of construction of switching units (psi elements).

ASSOCIATION: none

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L 21782-65 EWT(d)/EWP(1) Pg-4/Pk-4/Pl-4/Po-4/Pq-4/Pae IJP(c)/AFETR/APGC(b)/ RAEM(1)/ESD(dp) BC

ACCESSION NR: AP5004305 S/0042/64/019/006/0243/0244

AUTHOR: Barbashkin, Ye. A.

TITLE: Seminar on the theory of control systems with a variable structure

SOURCE: Uspekhi matematicheskikh nauk, v. 19, no. 6, 1964, 243-244

TOPIC TAGS: variable structure control system, control system stabilization invariant, control system, Lyapunov function method, small parameter method, control system synthesis, multiloop control system, pneumatic control system

ABSTRACT: The seminar on the theory of control systems with a variable structure held at the Sverdlovsk Branch of the Steklov Mathematical Institute of the Academy of Sciences SSSR from 22 to 25 May 1964 was attended by mathematicians, specialists in mechanics, and engineers from Sverdlovsk, Moscow, and Frunze. Eleven papers were presented on the following topics: 1) mathematical methods for studying control systems with a variable structure; 2) analysis and synthesis of control systems with a variable structure; and 3) engineering realization of control systems with a variable structure.

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Papers on mathematical methods for control systems with a variable structure were given by Ye. A. Barbashin (Stabilization of nonlinear systems), Ye. A. Gerashchenko (On the stabilization of control systems in a critical case), V. I. Utkin (Certain stability problems in systems with a variable structure, and The principles for designing a control system with a variable structure which are invariant with respect to disturbances), and R. M. Eydinov (On the evaluation of the time necessary to get into a sliding hyperplane). These papers analyzed the stability problem in control systems with a variable structure; great attention was paid to methods of a small parameter and of the Lyapunov function. It was pointed out that the method of a small parameter can be used not only to prove the stability of the control systems with a variable structure, but also to estimate the time necessary to get into a switching hyperplane.

In the paper by S. V. Yemel'yanov (Basic problems in the theory of automatic control systems), the results obtained by a group of co-workers of the Institute of Automatics and Telemechanics in the synthesis and analysis of control systems with a variable structure were summarized and the relationships between these systems and other systems (for example, with relay systems or systems with an infinitely large amplification factor) were

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analyzed. The importance of the method of phase-shift filters in the synthesis and analysis of such systems was stressed. M. A. Bermant (Structural transformation of control systems with a variable structure) analyzed the structural transformation of such systems by using the analogy between them and control systems with infinitely large amplification factors. V. A. Taran's paper (On the stability of motion of control systems with a variable structure when the information concerning the plant is incomplete) dealt with the synthesis of a control system when the information concerning the controlled process is imcomplete.

A paper by M. B. Gritsenko (The application of control systems with a variable structure in multiloop problems) dealt with the problem of self-regulation in multiloop control systems with a variable structure. A certain new class of control systems with a variable structure was studied by N. Ye. Kostylyeva (On free motion of one class of control systems with a variable structure). The possibility of using a unified system of pneumatic elements in the design of a control system with a variable structure was

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studied by M. S. Krasitskiy (The use of elements of the USEPPA system in designing automatic control systems with a variable structure). The principles of designing switching devices on the basis of pneumatic elements were presented.

ASSOCIATION: none

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"APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103530011-7

ACCESSION NR: AP4040578 S/0040/64/028/003/0523/0528

AUTHORS: Barbashin, Ye. A. (Sverdlovsk); Tabuyeva, V. A. (Sverdlovsk)

TITLE: Theorems on asymptotic stability of solutions of certain third order differential equations with discontinuous characteristics

SOURCE: Prikladnaya matematika i mekhanika, v. 28, no. 3, 1964, 523-528

TOPIC TAGS: asymptotic stability, differential equation, nonlinear control system, variable parameter

ABSTRACT: The authors treat the problem of stabilizing nonlinear third order control systems somewhat differently from their previous treatment (Teorema ob ustoychivosti resheniya odnogo differentsial'nogo uravneniya tret'yego poryadka s razryvnoy kharakteristikoy. PMM, 1963, v. 27, No. 4). Thus, in the present work, the introduction of additional variable parameters makes it possible to guarantee slipping for any motion during an entire time interval. Stability is attained by increasing certain of the system's parameters. The points of the phase space are translated first to some surface, and then (with slipping) attain motion along this surface to the origin. The authors are able to obtain asymptotic

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stability of the zero solution. The possibility of attaining asymptotic stability was established by V. P. Baranovskiy for the linear case of third order systems; his work is based on the cited article by the present authors. Orig. art. has: 17 formulas.

ASSOCIATION: none

SUBMITTED: 26Jan64 DATE ACQ: 19Jun64 ENCL: 00

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RAEM(i)/AMD/ASD(a)-5/ESD(dp)/ESD(t)/RAEM(t)/Pb-4 BC
ACCESSION NR: AP4043295 S/0040/64/028/004/0761/0765

45

AUTHOR: Barbashin, Ye. A.; Gerashchenko, Ye. I.

TITLE: On stabilization of control systems

SOURCE: Prikladnaya matematika i mekhanika, v. 28, no. 4, 1964, 761-765

TOPIC TAGS: control system stabilization, automatic regulation, cybernetics, control theory

ABSTRACTS: By means of the method of Lyapunov's functions, a general approach to the description of possible stabilization methods of the automatic regulation systems is considered. It is assumed that the transfer function of the object has (n-1) poles in the left semiplane and one simple null pole. The method for choosing the parameters is given which produce the asymptotic stability of systems of variable structures with an arresting device. Orig. art. has: no figures and 23 equations.

ASSOCIATION: None

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BARBASHIN, Ye. A., doktor fiz.-matem. nauk

Theory of control systems with variable structure; seminar in Sverdlovsk. Vest. AN SSSR 34 no.9:[illegible] S '6[illegible].

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[illegible], Ya.A. ([illegible]); [illegible]

[illegible] of [illegible] [illegible] no.5:[illegible] '65. (MIRA [illegible])

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L 52199-65 EWT(d)/EPF(n)-2/EWP(1) Po-4/Pq-4/Pg-4/Pu-4/Pk-4/Pl-4 IJP(c) WW/BC

ACCESSION NR: AP5012017 UR/0376/65/001/001/0025/0032

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AUTHORS: Barbashin, Ye. A.; Gerashchenko, Ye. I.

TITLE: Forcing of gliding conditions in automatic control systems

SOURCE: Differentsial'nyye uravneniya, v. 1, no. 1, 1965, 25-32

TOPIC TAGS: stability, differential equation, optimal control

ABSTRACT: The authors consider

$$\dddot{x}+a\ddot{x}+b\dot{x}+cx=-nKx, \quad (1)$$

which is equivalent to

$$\dot{x}=y,\ \dot{y}=z,\ \dot{z}=-cx-by-az-nKx\ . \quad (2)$$

Here a, b, c, K are arbitrary constants, $K > 0$. The quantity n is determined by

$$n=\operatorname{sign}[xA\operatorname{sign}x(y+Dx)+By+z]\,x, \quad (3)$$

where A, B, D are positive constants. The authors prove that if K is sufficiently large then all solutions of (2) satisfy

$$\lim_{t\to\infty} x(t) = \lim_{t\to\infty} y(t) = \lim_{t\to\infty} z(t) = 0$$

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by means of rather detailed phase plane analysis. This analysis illustrates the authors' assertions that a gliding state of highest order may exist only if the initial gliding state is described by differential equations with discontinuous characteristics. From this it follows that the basic n-1 dimensional gliding surface gives rise to nonidealness of gliding of higher order. Properly introducing the gliding surface, they effect passage of the system into an ideal gliding state, which then passes into a nonideal state with reduction in dimensionality. Orig. art. has: 24 formulas and 2 figures.

ASSOCIATION: Sverdlovskoye otdeleniye matematicheskogo instituta im. V. A. Steklova AN SSSR (Sverdlovsk Division, Mathematical Institute, AN SSSR)

SUBMITTED: 05Sep64 ENCL: 00 SUB CODE: MA

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L 9622-66 EWT(d)/EWT(1)/EWP(m)/EWA(d)/FCS(k)/EWA(1) IJP(c)

ACC NR: AP6000425 SOURCE CODE: UR/0140/65/000/005/0019/0026

AUTHORS: Barbashin, Ye. A. (Sverdlovsk); Kocheva, M. D. (Sverdlovsk)

ORG: none

TITLE: On the periodic motions of a double pendulum

SOURCE: IVUZ. Matematika, no. 5, 1965, 19-26

TOPIC TAGS: pendulum motion, periodic motion, existence theorem, vibration damping

ABSTRACT: The periodic motion of a double pendulum is investigated analytically in the presence of a damping medium and constant rotating forces imparted to the first and second pendulum. The nonlinear system of equations of motion for the pendulum is given by

$$
\begin{aligned}
\dot{\varphi}_1 &= y,\\
\dot{y} &= \frac{a}{l_1}\{-(m_1+m_2)g\sin\varphi_1 - l_1 a[m_1 + m_2\sin^2(\varphi_2-\varphi_1)]y + \\
&\quad + \Psi_1(\varphi_1, y, \varphi_2, z)\},\\
\dot{\varphi}_2 &= z,\\
\dot{z} &= \frac{a}{l_2}\{-(m_1+m_2)g\sin\varphi_2 - l_2 a[m_1 + m_2\sin^2(\varphi_2-\varphi_1)]z + \\
&\quad + \Psi_2(\varphi_1, y, \varphi_2, z)\},
\end{aligned} \qquad (1)
$$

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where α and the various γ's are functions of the pendulum masses, lengths, applied forces, and circular coordinates φ_1 and φ_2. These equations are then written as first order equations with a set of comparison equations, two of which have the form

$$\frac{dy^-}{d\varphi_1} = \frac{\alpha}{l_1}\left[\frac{-(m_1+m_2)g\sin\varphi_1 - q_2(y) + F_1 - k_1}{y}\right], \qquad (2)$$

$$\frac{dz^-}{d\varphi_2} = \frac{\alpha}{l_2}\left[\frac{-(m_1+m_2)g\sin\varphi_2 - q_2(z) + F_2' - k_2}{z}\right]. \qquad (3)$$

A four-dimensional cylindrical surface $R(\varphi_1, \varphi_2)$ is defined as the phase space of the above nonlinear pendulum equations, and the involute of this hypercylinder is designated by R. Four modes of periodic motions are identified, depending on whether the trajectory of the motion is closed or open on R, $R(\varphi_1)$, and $R(\varphi_2)$. The existence of the first and second periodic modes is proved by two theorems on the basis of two conditions for the two comparison equations listed above. A third existence theorem is proved which states: If equations (2) and (3) satisfy the conditions

$$0 < F_1 - k_1 < (m_1+m_2)g, \quad 0 < F_2' - k_2 < (m_1+m_2)g, \qquad (4)$$

the inequality exists

$$W_1^-(\zeta_0) > U_1^-(\zeta_0),$$
$$W_1^-(\zeta_0') > U_1^-(\zeta_0'), \qquad (5)$$

where the double pendulum has an aperiodic motion of the first kind. Orig. art. has: 27 equations and 3 figures.

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